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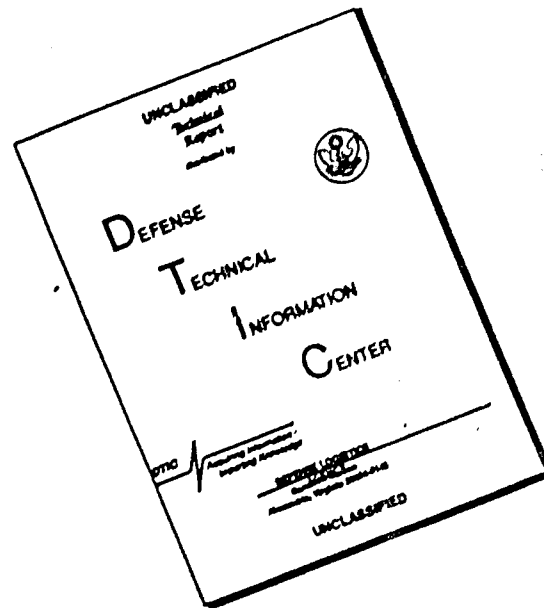


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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/660

Resistance of Nylon Parachute Cloth to Perforation by
Fragment-Simulating Projectiles

BY

J. F. SULLIVAN
Asst. Engineer

DATE 1 July 1944

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WATERTOWN, MASS.

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WATERTOWN ARSENAL LABORATORYMEMORANDUM REPORT NO. WAL 710/660First Partial Report on Problem R-8.8

1 July 1944

Resistance of Nylon Parachute Cloth to Perforation byFragment-Simulating Projectiles

1. In response to a request from the Office, Chief of Ordnance¹, samples of three types of nylon parachute cloth, as supplied by the Nylon Division of E. I. DuPont de Nemours and Company through the Huguet Fabrics Corporation, have recently been tested for perforation resistance at this arsenal.

2. The resistance of these samples to perforation by the 17-grain cal. .22 fragment-simulating projectile, G-2², was the highest afforded by any fabric tested here. Their resistance to perforation by cal. .45 (steel-jacketed) ball projectiles was slightly inferior to that of the most resistant fabric previously tested.

3. Sufficient numbers of 12"x12" pieces of each sample were cut, assembled, and sewed together to provide a weight-per-unit-area equivalent to that of .044" of steel, as currently employed in body armor assemblies. These assemblies were then mounted on a sawdust-filled canvas dummy and impacts of cal. .45 ball projectiles (steel-jacketed) and of the cal. .22 fragment-simulator were directed against them. The results of these tests appear in Table I.

4. Under impact of the cal. .22 projectile, G-2, the resistance of the three samples (1370, 1435 and 1435 feet-per-second) was better than that of 17½ ounce nylon duck previously tested (1360 feet-per-second)³ and comparable with that of another sample of nylon parachute cloth (equivalent in weight to .045" of steel) tested earlier

1. O.O. 423/7893 - Wtn 423/179, dated 22 May 1944.

2. Watertown Arsenal Laboratory Memorandum Report No. WAL 762/253, Development of a Projectile, to Be Used in Testing Body Armor, to Simulate Fragments of a 20 mm. H.M. Projectile, 7 January 1944.

3. Watertown Arsenal Laboratory Memorandum Report No. WAL 710/616, Resistance of Various Layers of 17½ Ounce Nylon to Several Types of Small Arms Projectiles, 22 April 1944.

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(1467 feet-per-second)⁴. Of all the fabrics tested here, the resistance of the subject material to perforation by the 17-grain fragment-simulator was the highest.

5. Under impact of the cal. .45 (steel-jacketed) ball projectile the resistance of these samples (676, 656 and 712 feet-per-second) was somewhat inferior to that of the 17½ ounce nylon duck (750 feet-per-second) and comparable to that of the more resistant of several samples of Fiberglas previously reported (549 to 738 feet-per-second)².

6. While the similarity in resistance of the three samples precludes any deductions as to effects of variable physical characteristics of the materials, a list of pertinent data furnished by the supplier appears as Table II.

7. If an all-fabric armor is seriously contemplated, therefore, the results of tests conducted at this arsenal indicate the advisability of using either the subject material or 17½ ounce nylon duck, since these materials are outstanding in overall resistance to extreme types of perforation as represented by the cal. .45 ball projectile and the cal. .22 fragment-simulator. As between these two materials, the subject material, while somewhat more bulky and obviously more expensive appears to be much more pliable and thus more suitable for fabrication into armor clothing.

4. Wtn 400.112/3082, dated 18 April 1944.

5. Watertown Arsenal Laboratory Memorandum Report No. WAL 710/653. Resistance of Various Samples of "Fiberglas" to Perforation by Fragment-Simulating Projectiles, 10 June 1944.

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Table I

Summary of Penetration Tests Conducted at Watertown Arsenal on
Samples of Nylon Parachute Cloth

<u>Sample</u>	<u>Equivalent Steel Gauge</u>	<u>Ballistic Limit (F/S)</u>	
		<u>G-2¹</u>	<u>Cal. .45²</u>
NFD-168/3	.044"	1370	676
NFD-170	.044"	1435	656
NFD-172	.044"	1435	712

For Comparison:

17½ oz. Nylon duck	.044"	1360	750
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¹Cal. .22 fragment-simulating projectile - 17 grains.
²Cal. .45 (steel-jacketed) ball projectile - 230 grains.

Table II

Data Concerning Three Samples of Nylon Parachute Cloth

As Reported by E. I. DuPont de Nemours and Company

du Pont Style No.	NFD-170	NFD-168/3	NFD-172
Yarn type	Bright	Bright	Bright
	High Ten-	High Ten-	High Ten-
	acity	acity	acity
Yarn count: Warp	70-23-5	70-23-7	105-34-5
Filling	70-23-5	70-23-7	105-34-5
Weave	Cargo	2 x 1 Twill	Taffeta
		Rip-Stop	
Construction (Loom count)	80 x 84	84 x 92	60 x 64
Reed	40/2	42/2	30/2
Reed width	40"	40.9	40"
Pickwheel	84	90	64
Finisher	Huguet	Huguet	Huguet
Finished Construction	90 x 88	96 x 98	68 x 67
Finished width	35 1/8"	36"	34 3/4"
Porosity	115	128	81
Thickness	0.0055"	0.0056"	0.0062"
Weight (oz./sq. yd.)	1.33	2.00	2.04
Tensile Strength (1" strip)	94 x 85 lbs.	99 x 98 lbs.	111 x 104 lbs.
Tear (Tongue)	6.8 x 7.2	12.7 x 12.1	9.6 x 9.4 lbs.
	lbs.	lbs.	
Tear (Trapezoid)	14.3 x 16.7		29.5 x 27.0
	lbs.		lbs.
Elongation	26 x 38%	25 x 32%	23 x 34%